Improvements in or relating to determining the temperature at which a substance changes state.

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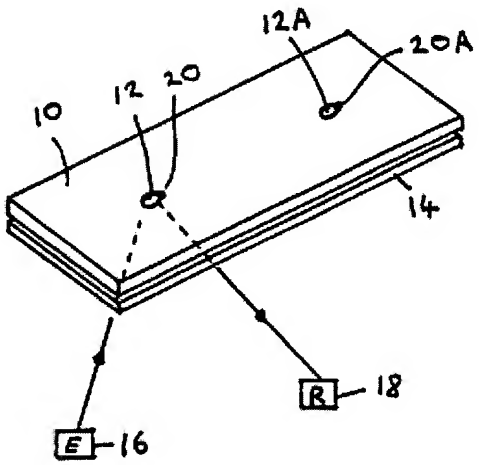
Abstract of **EP0397936**

Infra red light from an emitter 16 is directed through a glass slide 10 to an area 12 on which a solid substance is located. Light reflected from the undersurface of the solid substance is received by a receiver 18. The substance is heated by a strip heater 14. When the substance changes state the amount of reflected light arriving at the receiver 18 varies, and information coming from an electronic thermometer 20 or 20A records the temperature at which the change of state has occurred.



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(54) Improvements in or relating to determining the temperature at which a substance changes state.

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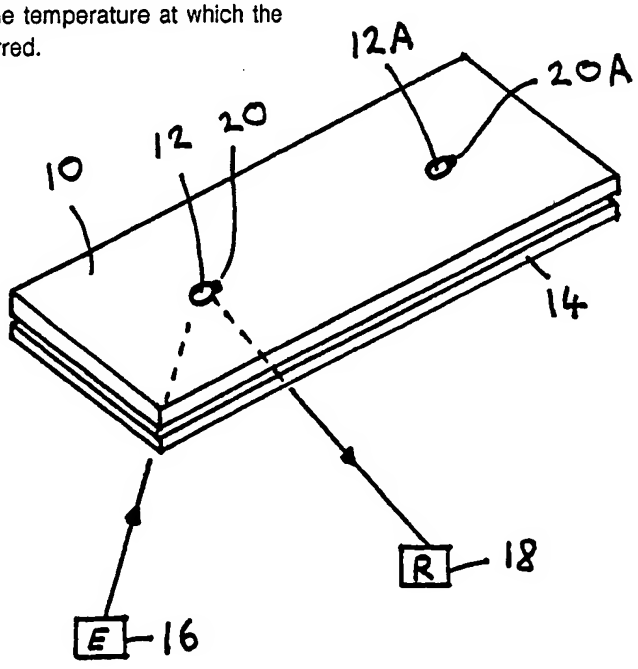

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IMPROVEMENTS IN OR RELATING TO DETERMINING THE TEMPERATURE AT WHICH A SUBSTANCE CHANGES STATE.

The present invention relates to a method of and apparatus for determining the temperature at which a substance changes state and is particularly, although not exclusively, concerned with determining the melting point of a substance.

A prior method of determining the melting point of a substance comprises emitting light from a source and directing that light at a solid substance. A photocell is located on the other side of the substance to receive any light transmitted through the substance. The substance is then heated. Some melted substances allow more light to be transmitted therethrough when they are melted and the increase in light transmitted through the substance indicates the melting point temperature of the substance. However, some substances become frothy or are dark when they melt and thus there may be no light, or no change in light received by the photocell, or no such discernible change when the substance melts thereby rendering determination of the melting point impossible with this method. Furthermore, the substance is placed in a capillary tube prior to having light directed at it which is a difficult and messy operation to perform.

According to one aspect of the present invention, a method of determining the temperature at which a substance changes state comprises monitoring a change in light reflected from the substance when the substance undergoes at least a partial change in state. Such a method may provide an accurate means for determining the temperature at which the substance changes state, even when there may be no change in the light (if any) which can be transmitted through the substance in the different states, as it has been found that there is a change in reflectivity for all tested substances when there is a change in state.

The method may comprise monitoring reflected visible or invisible light such as infra red light.

The method may comprise heating the substance for instance by a strip heater.

The method may comprise monitoring at least a partial change of state from a solid to a liquid in which case the light may be transmitted through or absorbed by the liquid, either totally or partially. The method may comprise determining the melting point of the substance.

The method may comprise determining the temperature at which a crystalline powder changes state.

The method may further include monitoring the temperature of an area spaced from the substance and, alternatively or additionally, monitoring the temperature of the substance, and that area may include the same substance.

The method may comprise monitoring light reflected from a downwardly facing surface of the substance, for instance through a supporting surface for the substance.

The method may comprise mounting a smear of substance.

The method may comprise directing light towards the substance.

The method may comprise cooling the substance, or cooling a surface on which it is mounted, after it has melted, possibly by cooling with a fan.

According to another aspect of the present invention, monitoring apparatus includes a test region in which a substance to be monitored is arranged to be located, and a receiver arranged to receive light reflected from a substance located at the test region and monitoring means arranged to determine when there has been a change in the light reflected from a substance located in the test region occasioned by such a substance at least partially changing state.

The apparatus may include a light source, which may comprise visible, invisible or infra red light, arranged to direct light at a substance located in the test region.

The apparatus may include heating means arranged to heat a substance located in the test region. The heater may comprise a strip heater.

The apparatus may include temperature monitoring means arranged to monitor the temperature of a substance located in the test region. The temperature monitoring means may, alternatively or additionally, be arranged to monitor the temperature of a region spaced from the test region.

The apparatus may include means arranged to store or indicate the temperature at which a substance has at least partially changed state.

The present invention also includes a monitoring apparatus when used in a method as herein described.

The present invention may be carried into practice in various ways, but one embodiment will now be described by way of example and with reference to the accompanying drawing which is a schematic representation of melting point determination apparatus.

A glass slide 10 has two areas 12 and 12A on each of which smear of the sample to be tested is located. The slide 10 is placed on a strip heater 14 and light from an emitter 16 is directed through an opening in the strip heater, through the glass slide, against the downwardly facing surface of the smear of sample in area 12. Any light reflected from the

downwardly facing surface of the smear is directed towards a receiver 18.

To conduct a test to determine the melting point of a substance, infra red light from the emitter 16 is directed towards the solid smear on the slide, and heat is supplied gradually to the substance by the heater 14. The temperature of the substance in area 12 is monitored by an electronic thermometer 20 and the temperature in area 12A is monitored by a further electronic thermometer 20A.

Whilst the substance in area 12 remains solid, the majority of the infra red light is reflected from the sample back to the receiver 18. As soon as the substance turns to liquid either the light from the emitter will mostly pass upwardly through the sample (should the liquid be relatively clear) or most of the light will be absorbed into the liquid (should the liquid be dark or frothy). In any event there will be a change in the amount of light arriving at the receiver when the substance melts.

The temperature of the thermometer 20 is monitored and recorded at the instant when there is a change in the reflected light.

The purpose of the thermometer 20A is to confirm that the temperature of the sample smear being tested is accurate. The temperature from the thermometer 20A is also monitored and recorded and compared to the temperature from the thermometer 20. Bearing in mind that the conditions for both areas 12 and 12A are the same, the temperatures of those areas should also be the same: If they are not the same then the test is repeated. In an alternative embodiment there is only a thermometer at the area 12A, away from the sample being tested, and the temperature of that thermometer is monitored.

The apparatus is particularly suited to determining the melting point of crystalline powders. Should noxious gasses be emitted on melting then the extremely small size of smear which is tested limits the amount of gas which is emitted. Furthermore, the heater may be arranged to be switched off automatically when the substance melts. Alternatively or additionally a fan may cool the substance once melted or alternatively or additionally the apparatus may be encased in an air tight unit.

Claims

1. A method of determining the temperature at which a substance changes state comprising monitoring a change in light reflected from the substance when the substance undergoes at least a partial change in state.

2. A method as claimed in Claim 1 comprising monitoring reflected infra red light.

3. A method as claimed in any preceding claim comprising monitoring a change of state from a solid to a liquid.

4. A method as claimed in Claim 3 in which no discernible light is reflected from the substance when it changes state from a solid to a liquid.

5. A method as claimed in any preceding claim comprising monitoring the temperature of an area spaced from the substance.

6. A method as claimed in any preceding claim comprising monitoring light reflected from a downwardly facing surface of the substance.

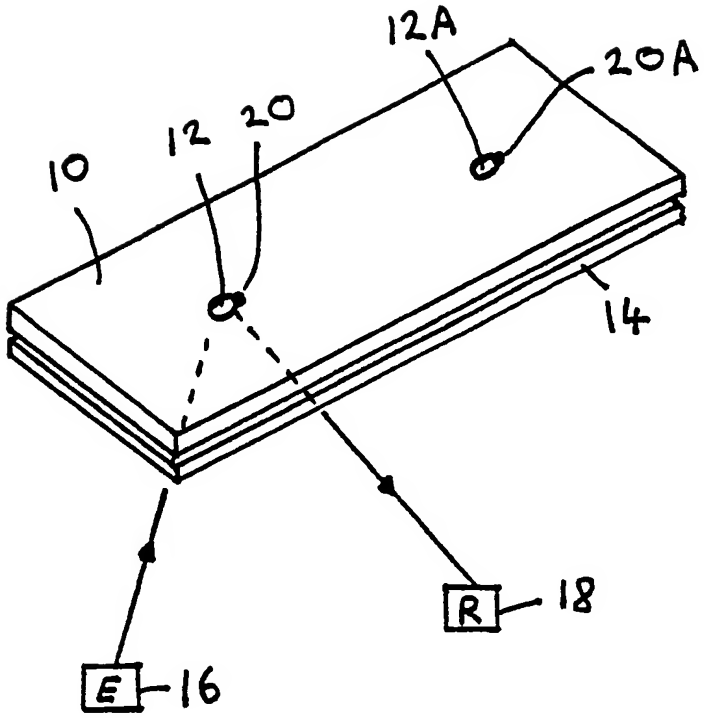
7. A method as claimed in claim 6 comprising monitoring light reflected through a supporting surface for the substance.

8. Monitoring apparatus including a test region in which a substance to be monitored is arranged to be located, and a receiver arranged to receive light reflected from a substance located at the test region and monitoring means arranged to determine when there has been a change in light reflected from a substance located in the test region occasioned by such a substance at least partially changing state.

9. Apparatus as claimed in Claim 8 including heating means arranged to heat a substance located in the test region.

10. Apparatus as claimed in Claim 8 or 9 including temperature monitoring means arranged to monitor the temperature of a region spaced from the test region.

11. Apparatus as claimed in any of Claims 8 to 10 including means arranged to store or indicate the temperature at which a substance has at least partially changed state.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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 4936

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A-2 202 941 (D.H. WASHBOURN) * Front page *	1,3-5	G 01 N 25/04
A	US-A-3 161 039 (S.F. KAPFF) * Figure 2 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G 01 N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-11-1989	DUCHATELLIER M.A.

CATEGORY OF CITED DOCUMENTS

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